Water Quality
Supplement 5.3

Water Facts

Facts by Topics

Hard Water/Buffers/Base/Acids

Hard water is caused by constituents that are dissolved in water. Many kinds of minerals add to water hardness, but calcium and magnesium are the primary constituents. Buffers are chemicals that neutralize acids and bases to change their pH. However, the buffer's pH doesn't change much in the process. A base is an alkaline chemical that has a pH greater than 7.0. Buffers of any pH may be prepared. For example, if you put a pH 4 buffer into pH 6 solution, the buffer will try to bring the solution's pH to 4. Put the buffer in a pH 3 solution and it will still try to bring the pH to 4. Because cleaning enzymes work best near pH 8, buffers of this approximate pH are added to detergents to control wash water pH.

Acid Rain

Sulfuric acid is the primary cause of acid rain. Nitric acid takes second place. Cars contribute nitrous oxide which can form nitric acid. Normal rain averages a 5.6 pH. Neutral water is 7.0. Rainfall is 5.6 pH because rainwater dissolves carbon dioxide to form a weak carbonic acid. Rainfall with a lower pH is called acid rain.

Ecology and Water

Ecology is the study of living organisms and their environmental relationships. We study ecology because environmental changes affect us directly. For example, herbicides in water may be absorbed by aquatic organisms that are eaten by fish. If we eat the fish, the contaminant may get to us. When fish or birds unnaturally decline in numbers, something is wrong with the environment.

Eutrophication

Eutrophication is a natural, evolutionary process whereby lakes fill in and are replaced by forests. The premature aging and death of a body of water can be caused by nutrient build-up and lack of oxygen. Nutrients (fertilizers) get in water, causing algae to grow. The algae respire (take in oxygen, give off carbon dioxide) and use up oxygen needed by fish. Eventually, the lake fills in with weeds and dies.

Herbicides and the Growth of Algae

When weeds are killed by herbicides, they sink to the lake bottom and decay. Decaying weeds provide nutrients for more weeds to grow. The following year, there will be more weeds than before. A better way to clear weeds may be to use a weed combine. Nitrates and phosphates are the main nutrients used by algae. Most nitrates and phosphates come from farm fertilizers. Leaking septic tanks and animal manure are also nitrate and phosphate sources.

Bioaccumulates

When a substance bioaccumulates, it builds up in the body over time. Thus, continuous exposure to small amounts of the substance can do severe damage to animals and humans. Lead, chromium and mercury are examples of metals which bioaccumulate. Slight exposure to lead over a long period of time can be dangerous. Some insect venoms bioaccumulate over time.

Synergy and Chemicals

Synergy is the process whereby two or more chemicals (or events) combine to produce a product that is greater than their sum. For example, if there is mercury in water, the fish will be harmed slightly. If the water is acidic (low pH from acid rain), the fish also will be harmed slightly. But if mercury is present in acidic water, fish gills and bones will be severely damaged by their combined effects.

Sanitary Landfills and Water

Sanitary landfills usually have rules about what can and cannot be disposed of. Usually these rules prohibit disposal of pesticides, paints, surgical hospital wastes, bulk detergents and poisonous chemicals. But people often disobey the rules and these materials often end up in sanitary landfills. Then, every time it rains, water seeps into the ground and washes over the buried wastes, ultimately polluting the ground water.

Mining Ground Water

We are mining our ground water by taking it out of the ground faster than nature is replacing it. Ground water moves very slowly, generally only a few feet a year. It may take years to naturally replenish the ground water we remove from an aquifer. That's why we must learn to conserve water. Most of our country's water is stored below ground in deep water aquifers.

Acid Rain Effects of Various Rocks

When acid rain is located on a granite bedrock that has no buffering ability against acid rain's effects, acid rain is more serious. Acid rain can be buffered by alkaline particles in air or soils. Limestone rock, on the other hand, has good buffering ability so acid rain isn't as serious a problem. If a lake has poor buffering capacity and is located in the path of polluted winds, the effects of acid rain will be twice as bad.

Chlorine/Decomposition

Chlorine will kill bacteria feeding on solid waste, so that the waste will not decompose. With no decomposers, the waste floats down the river until it reaches a location where decomposers (bacteria) are again present. Then decomposition will begin. It is important to remove chlorine from wastewater before the water is released into the river. It is a good idea to avoid putting chemicals down the sink drain or toilet if you have a septic tank.

Water Treatment

There are three stages of water treatment. Primary treatment filters out the big particles. This is the mechanical stage of wastewater treatment. The secondary

treatment is called the biological phase, because it involves microorganisms eating up the wastes. Advance treatment is the chemical stage. After microorganisms have eaten most of the solid waste, the water is treated further to remove constituents like ammonia and phosphorus.

Examples of Miscellaneous Water Facts and Related Terms

Water is one of the most stable chemical compounds. Acids and bases cannot break it down; only electrical storms can make it unstable.

Soil does not filter all contamination from water when it passes through the ground. Ground water is vulnerable to pollution because the surface water that recharges it can carry many types of pollutants with it.

Contaminants dumped on the ground or buried can find their way into ground water, as can airborne pollutants when it rains or snows.

Improperly maintained septic systems, leaking underground oil storage tanks and landfills all contaminate ground water.

Water pollutants include six kinds—biodegradable, plant nutrients, heat (thermal pollution), sediments, poisonous and nonpoisonous chemicals and radioactive wastes.

Biodegradable products can harm the environment because they provide food for bacteria.

When aerobic bacteria eat garbage they multiply and consume large amounts of oxygen needed for fish and aquatic animals.

Not all bacteria are beneficial and necessary for decomposing biodegradable wastes. Some bacteria are pathogenic and are capable of causing disease. Diseases like typhoid, cholera and dysentery are carried by water.

Chlorine is an effective disinfectant and, at high concentration, also destroys many viruses.

If a house is too close to a waterway, toilet wastes and ground-up garbage may seep into the water causing increased plant growth, increased bacteria levels, which reduces the amount of oxygen and increased pathogens.

An important physical relationship exists between the amount of dissolved oxygen in a body of water and its temperature. The warmer the water, the less dissolved oxygen. For this reason, thermal pollution is a very real problem.

It is not possible to drink salt water.

Siltation in streams is one of our greatest water pollution problems. Its major cause is soil erosion resulting from poor logging practices, poor farming practices and strip mining.

The geology and vegetation of a watershed also affects the siltation process. If the water shed is rocky with little plant life, top soil will wash into the waterway with every rain, and may result in flooding.

Dredging removes submerged rocks and logs where fish and small aquatic animals live. Dredging is perhaps a necessary evil on industrial rivers, although it is not a good environmental practice.

Lime, or calcium carbonate, is a compound composed of the elements calcium, carbon and oxygen.

In winter, huge ice masses form in ocean water. These ice masses contain no salt and could be melted and used for drinking water.

Many glaciers formed during the last ice age are still around.

When the air contains all the moisture it can hold at a given temperature, the relative humidity is 100%.

Farmers use large amounts of water to irrigate their lands.

Billions of gallons of fresh water are stored below the earth in deep aquifers.

The EPA is the only federal agency that is responsible for protecting the environment at large, including water. Other government agencies, such as the National Park Service and the US Forest Service work within their boundaries and buffer zones.

The hydrologic cycle carries rain and snow to rivers, streams, lakes and oceans. Then this water evaporates and returns as rain.

Lemon juice is an acid, and all acids taste sour. Baking soda is alkaline and will neutralize the sour taste of lemon juice.

The water in some ponds lies still and has no current. Algae may build up and completely cover shallow, stagnant ponds.

Water must be desalinated before we can use it.

When rain/snow reaches a nonporous layer of rock (bedrock), it follows the slope of the rock and eventually finds its way to streams, rivers, lakes and ocean.

A lot of our shallow ground water has been contaminated by waste materials poured onto the ground by city and industrial workers and other individuals.
Water sometimes is contaminated with carcinogens (cancer-causing chemicals).

At any given time, specific water molecules may exist as surface water, ground water or atmospheric moisture in the hydrologic cycle.

Alkalinity is a total measure of the substances in water that have acid-neutralizing ability.

Alkalinity indicates a solution's power to react with acid and its power to keep its pH from changing (buffer).

pH measures the strength of an acid or base.

Limestone is rich in carbonates, so water flowing through limestone regions generally have alkalinity—good buffering capacity. Granite areas have low alkalinity and poor buffering capacity.

Ammonia makes a powerful cleaning agent when mixed with water. Like nitrates, ammonia may speed the process of eutrophication in waterways.

More oxygen is used and more carbon dioxide enters waterways at night than during the daytime because plants respire and burn food they made during the day when photosynthesis occurred.

Carbon dioxide quickly combines in water to form carbonic acid, a weak acid.

Chlorides are found in nearly all rivers, lakes and streams.

Because chlorine is an excellent disinfectant, it is commonly added to most drinking water supplies in the United States.

Chlorine gas, dissolved in water, is toxic to fish and aquatic organisms, even in very small quantities.

Hardness is defined as the amount of calcium and magnesium in the water, because these two minerals are chiefly responsible for hard water.

Variables that affect a waterway's temperature include—color, depth, amount of shade, latitude, time of year, the temperature of the water supplying it, volume and the temperature of effluents dumped into the water.

Turbidity answers the question, "How cloudy is the water?"